National Institute of Environmental Health Sciences

Modeling to predict cases of Hantavirus Pulmonary Syndrome in Chile

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Abstract:

Background:Hantavirus pulmonary syndrome (HPS) is a life threatening disease transmitted by the rodent Oligoryzomys longicaudatus in Chile. Hantavirus outbreaks are typically small and geographically confined. Several studies have estimated risk based on spatial and temporal distribution of cases in relation to climate and environmental variables, but few have considered climatological modeling of HPS incidence for monitoring and forecasting purposes.Methodology:Monthly counts of confirmed HPS cases were obtained from the Chilean Ministry of Health for 2001-2012. There were an estimated 667 confirmed HPS cases. The data suggested a seasonal trend, which appeared to correlate with changes in climatological variables such as temperature, precipitation, and humidity. We considered several Auto Regressive Integrated Moving Average (ARIMA) time-series models and regression models with ARIMA errors with one or a combination of these climate variables as covariates. We adopted an information-theoretic approach to model ranking and selection. Data from 2001-2009 were used in fitting and data from January 2010 to December 2012 were used for one-step-ahead predictions.Results:We focused on six models. In a baseline model, future HPS cases were forecasted from previous incidence; the other models included climate variables as covariates. The baseline model had a Corrected Akaike Information Criterion (AICc) of 444.98, and the top ranked model, which included precipitation, had an AICc of 437.62. Although the AICc of the top ranked model only provided a 1.65% improvement to the baseline AICc, the empirical support was 39 times stronger relative to the baseline model.Conclusions:Instead of choosing a single model, we present a set of candidate models that can be used in modeling and forecasting confirmed HPS cases in Chile. The models can be improved by using data at the regional level and easily extended to other countries with seasonal incidence of HPS.

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Resource Description

Early Warning System: ☑

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Meteorological Factors, Precipitation, Temperature

Temperature: Fluctuations

Geographic Feature: ☑

resource focuses on specific type of geography

None or Unspecified

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Central/South America

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease, Zoonotic Disease

Zoonotic Disease: Hantavirus Pulmonary Syndrome

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Methodology, Outcome Change Prediction

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content